

An Evaluation of Lung Counting Background at Six Facilities using an 80-mm Diameter Germanium Detector: A Collaborative *In Vivo* Study

¹Joel L. Webb, ²Gary Kramer, ³Steve Allen, ⁴Malcolm Ennis, ⁵Raymond Guilmette, ⁶Timothy Lynch and ¹David Schoep

¹Carlsbad Environmental Monitoring & Research Center, New Mexico State University; Carlsbad, New Mexico, USA

²Human Monitoring Laboratory, Environmental Radiation Hazards Division, Radiation Protection Bureau; Ottawa, Ontario, Canada

³Cameco Corporation; Port Hope, Ontario, Canada

⁴Los Alamos National Laboratory; Los Alamos, New Mexico

⁵Lovelace Respiratory Research Institute, Albuquerque, New Mexico (currently Los Alamos National Laboratory; Los Alamos, New Mexico)

⁶Battelle Northwest Division; Richland, Washington

A collaborative study between the Carlsbad Environmental Monitoring and Research Center, New Mexico State University; Human Monitoring Laboratory, Health Canada; Cameco Corporation; Los Alamos National Laboratory; Lovelace Respiratory Research Institute and Battelle Northwest Division was conducted to intercompare lung counting background between the six facilities. Between the six facilities, measurements were made on 11 *in vivo* counting shields, ranging in thickness from 13 to 25 cm. One objective of the study was to eliminate site specific biases due to the different measurement systems present at each facility. This was achieved by performing all background measurements with the same detector, signal processing electronics and experimental protocol at each facility. This approach allows a direct comparison of background data between the facilities. All background measurements were performed using a single broad energy germanium (BEGe) detector manufactured by Canberra Industries^a (80 mm diameter by 20 mm thick). A BEGe detector provides resolution performance (450 and 750 eV resolution at 5.9 and 122 keV, respectively) similar to typical low photon energy Ge detectors of thin coaxial or planar design. The added benefit of a BEGe detector is that high energy resolution performance is similar to that of cylindrical coaxial detectors (2100 eV resolution at 1333 keV). The BEGe is a directional detector fitted with a thin, 0.6 mm, entrance window constructed of carbon composite. Pulse height data were collected using a portable multi-channel analyser (InSpector), which was also manufactured by Canberra Industries. For each lung counting shield at each facility, background spectra from 9 to 350 keV were collected outside the shield, inside the shield with the shield empty and inside the shield with a human present.

^aCanberra Industries, 800 Research Parkway, Meriden, Connecticut 06450

oral